Standard Operating Procedures

for the Deep Creek Watershed Restoration

2015 Sampling and Analysis Plan

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Introduction

This document serves as field sampling procedures manual for the Deep Creek watershed restoration monitoring program. The Deep Creek watershed is located just east Townsend, MT and flows roughly 30 river miles from the West slope of the Big Belt Mountains to its confluence with the Missouri River. The monitoring program will focus on the lower watershed, containing the Deep Creek WRP "project reach," which includes about 20.7 river miles from the United States Forest Service (USFS) boundary to the Missouri (see figure 1).

This monitoring plan will serve two purposes. First, it will provide project partners the ability to draw conclusions about the effectiveness of the Deep Creek watershed restoration project and assess whether targets outlined in the Watershed Restoration Plan (WRP) are being achieved. Second, it will build upon the efforts of previous monitoring assessments, allowing for trends in the condition of Deep Creek to be evaluated over time. See the Sampling and Analysis plan for a thorough explanation of the Deep Creek Watershed Restoration Plan.

These monitoring efforts will be implemented over the next ten years with the support of data collectors Jim Beck, Associate Supervisor and monitoring volunteer for Broadwater Conservation District's (BCD), Ron Spoon, Fisheries Biologist for MT Fish, Wildlife, and Parks, Natural Resource Conservation Service (NRCS) Townsend Field office employees, and present and future Big Sky Watershed Corps (BSWC) members and/or MSU interns. If local volunteer's sign up for this project and are properly trained in data collection methods in future years, their efforts may be included in this study.

The techniques described herein depict the methods for data collection for each monitoring parameter addressed in the SAP. All who collect data for the Deep Creek Watershed Monitoring Program are encouraged to use this as a reference during sampling events.

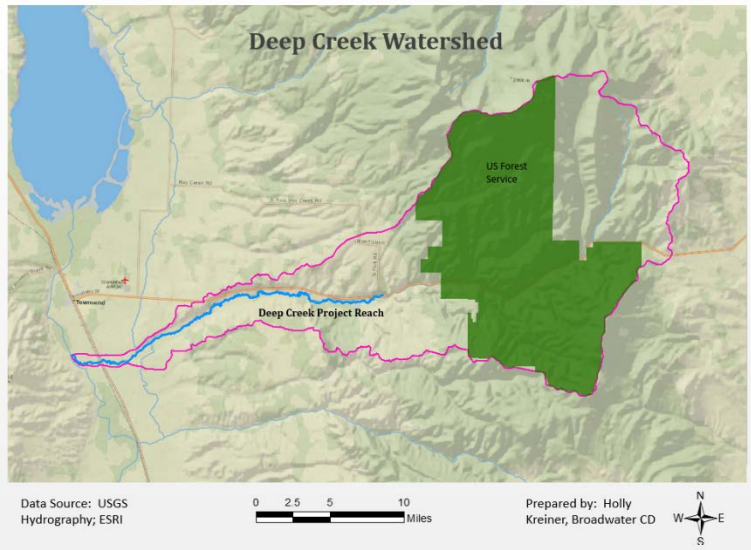


Figure 1 – Deep Creek watershed and depiction of project reach

Sampling Sites

A total of 25 on-going monitoring locations have been chosen for the Deep Creek monitoring project. The locations of each sampling site is provided below. An entire page is dedicated to each *flow monitoring* site to aid in navigation to these sites. The flow sampling sites will be listed from the upper most to the lowest location, for easier navigation to each site within this document.

Deep Creek Sampling Locations

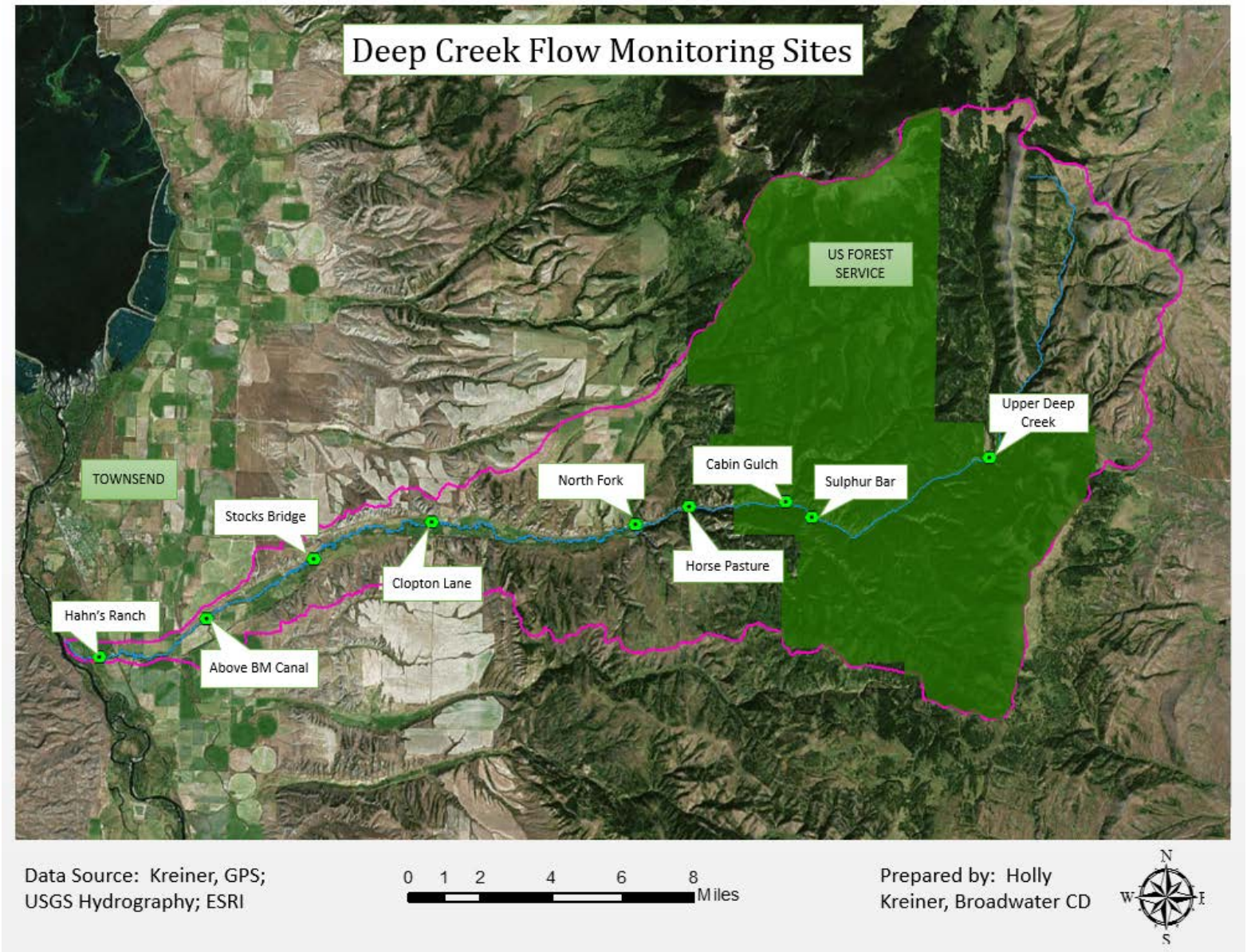
Table 1 – On-going monitoring sites and their respective monitoring parameter and coordinates

Site ID; Site Name	Latitude	Longitude	Monitoring Parameter
DC- U; *Upper Deep Creek*	46.34894	-111.13592	Flow, Photopoint
DC-SB; *Sulphur Bar*	46.33049	-111.20977	Flow, Photopoint
DC-CG; *Cabin Gulch*	46.33501	-111.220828	Flow, Photopoint
DC-HP; *Horse Pasture*	46.33297	-111.26112	Flow, Temperature, Photopoint
DC-NF; *North Fork*	46.32752	-111.28308	Flow, Photopoint
DC-CL; *Clopton Lane*	46.32681	-111.36844	Flow, Temperature, Photopoint
DC-S; *Stock's Bridge*	46.31509	-111.41744	Flow, Photopoint
DC-BM; *Above Broadwater Missouri Canal*	46.29708	-111.46201	Flow, Temperature, Photopoint
DC-HR; *Hahn's Ranch*	46.28514	-111.50617	Flow, Temperature, Photopoint
DC–XS-1	TBD	TBD	Cross-section, Photopoint
DC–XS-2	TBD	TBD	Cross-section, Photopoint
DC–X -3	TBD	TBD	Cross-section, Photopoint
DC–XS-4	TBD	TBD	Cross-section, Photopoint
DC–XS-5	TBD	TBD	Cross-section, Photopoint
DC–XS-6	TBD	TBD	Cross-section, Photopoint
DC–XS-7	TBD	TBD	Cross-section, Photopoint
DC–XS-9	TBD	TBD	Cross-section, Photopoint
DC –XS -10	TBD	TBD	Cross-section, Photopoint
DC-CL-HWY12; *Redd/Beaver reach*	46.32669 -111.36868 *through* 46.32465 -111.29332		Redd/Beaver dam count
DC-HR-FISH; *Above Montana Ditch*	46.28479	-111.51181	Juvenile, Out-migrant trout count
DC-R-FISH; *Reiders*	46.30334	-111.44510	Resident trout count

Table 2 – HUC codes for all streams included in this study

HUC (hydrologic Unit Codes) for Streams	
Russell Fork	100301010802
Sulphur Bar	100301010804
Cabin Gulch	100301010804
North Fork	100301010803
Clopton Lane	100301010805
Stock's Bridge	100301010805
Lower Deep Creek Bridge	100301010805
Hahn Ranch	100301010805

Figure 2 - Location of Deep Creek flow monitoring sites



Upper Deep Creek

Figure 3 - Standing at measuring cross-section, looking downstream

Figure 4 – Aerial image of parking spot and navigation to stream site; credit Googlemaps

Navigating to the site: To get to the Upper Deep Creek site, head east on Highway 12 from Townsend through Deep Creek canyon. The pull-off to the Upper Deep Creek site is marked by the "Thomason" property entrance on the left-hand side and between mile marker 19 and 20. Park just left of the shed, head right and cross over fence to get to the stream (see figure 3). Monitoring site can be located by highlighted bank pins (~175' upstream of highway) and a 1-inch diameter stilling well housing for the TruTrack logger.

Sulphur Bar

Figure 5 - Standing at measuring cross-section, looking upstream

Figure 6 - Aerial image of stream site (parking spot immediately adjacent); credit Googlemaps

Navigating to the site: From Townsend, take Highway 12 East up Deep Creek Canyon. Sulphur Bar pull-off is located between mile marker 15 and 16 and is the first right turn past the "Sulphur Bar" sign. Drive over the bridge and park on the left just before the Forest Service gate and next to the stream (see figure 5). Monitoring site can be located by highlighted bank pins and a 1-inch diameter stilling well housing for the TruTrack logger just downstream of Forest Service gate (~350 feet from highway)

Cabin Gulch

Figure 7 – Standing at measuring cross-section, looking downstream

Navigating to the site: The Cabin Gulch site is less than a mile downstream of Sulphur Bar, located between mile marker 14 and 15 of Highway 12 East. From Townsend, pull-off is on the left hand side and is indicated by "Cabin Gulch" road sign. Park on the first pull-off on the road (facing a gated private road) and walk up Cabin Gulch road (note: *not* the gated road) about 50 feet and turn right to access site. Measuring cross-section is ~450' from highway. Highlighted bank pins are *not* located at this site, so be sure to located metal fence posts to find established cross-section. Stilling well is located just downstream of cross-section.

Figure 8 - Aerial image of parking spot and navigation to stream site; credit Googlemaps

Horse Pasture

Figure 9 - Standing at measuring cross-section, looking downstream

Figure 10 - Aerial image of parking spot and navigation to stream site; credit Googlemaps

Navigating to the site: Heading east on Highway 12, the Horse Pasture site is located between mile marker 12 and 13 about a mile below the official Forest Service boundary. Watch for wooden fence and take the pull-off on the right to park in front of the gate (note: slow down as soon as you approach fence as it is easy to pass this pull-off). Jump over fence and follow navigate to a poorly worn trail that heads to the left side of the paddock. Follow trail to the left-hand side of fence and down to stream site. You will see field instruments just in front of fence. Measuring cross-section bank pins are located just *above* fence, which is accessed most easily by wading under fence.

North Fork

Figure 11 - Standing at measuring cross-section, looking downstream

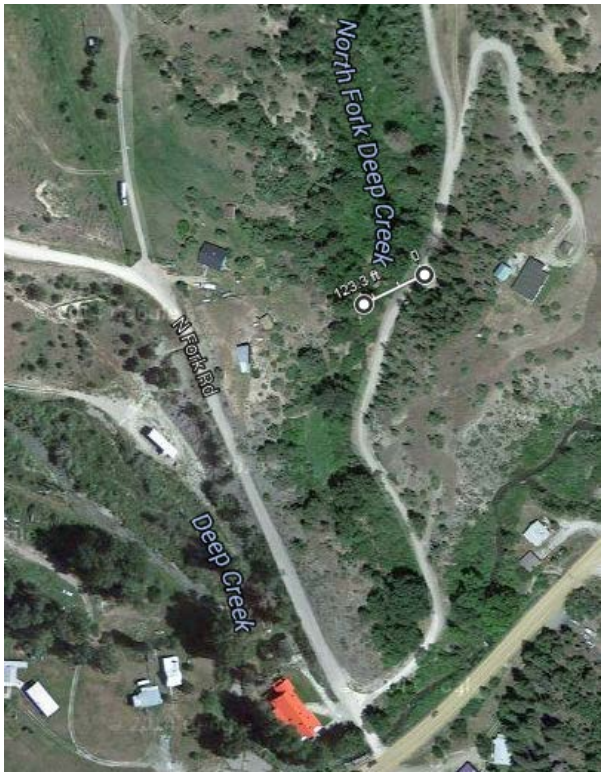


Figure 12 - Aerial image of parking spot and navigation to stream site; credit Googlemaps

Navigating to the site: The North Fork road turn-off is a left-hand turn between mile marker 11-12 on Highway 12 East. As soon as you go over Deep Creek, take a right onto Log Cabin Road and follow that road for several hundred yards until you reach a conspicuous pull-off on the right (see figure 11). Find a path through the woods just to the left of the parking space and walk ~100 feet down to the still well site. Measuring cross-section and highlighted bank pins are located about ~30 feet upstream of still well. Site is ~ 900 feet upstream from highway.

Clopton Lane

Figure 13 - Standing just below bridge, looking upstream

Navigating to the site: Head east on Highway 12, Clopton Lane Road is located on the right-hand side between mile marker 7-8. Follow the road down and park on the right just before the bridge over Deep Creek (see figure 13). To access the site, cross over the barbed fence to the left of the road and walk down to stream. Highlighted bank pin for measuring cross-section visible in the gravel bar. Bubbler and staff gauge attached to bridge and stilling well is accessible at the top of bridge. Cross-section ~125 feet from Clopton Lane Bridge.

Figure 14 - Aerial image of parking spot and navigation to stream site; credit Googlemaps

Stock's Bridge

Figure 15 – Standing on Stock's bridge, looking upstream

Figure 16 - Aerial image of parking spot and navigation to stream site; credit Googlemaps

Navigating to the site:
Heading on Highway 12 East from Townsend, turn right on Lower Deep Creek Road between mile marker 5 and 6. The pull-off is a private road on the left, approximately 1 mile down. This road is gated and you will need a key to access. Head down about ¼ mile and as soon as you cross private bridge, park on the left. Jump the fence to the left and follow established path through the brush to access measuring cross-section**,** ~ 50 feet from bridge.

Above Broadwater Missouri Canal

Figure 17 – Standing at measuring cross-section, looking upstream

Figure 18 - Aerial image of parking spot and navigation to stream site; credit Goolemaps

Navigating to the site:
Lower Deep Creek Road can be accessed from either Highway 12 or Highway 287. If taking Highway 12, turn right and head down Lower Deep Creek Road. If taking Highway 287 from Townsend, turn left on Lower Deep Creek Road and head up the road. Above BM Canal site is located around the halfway point on Lower Deep Creek Road. From Highway 287, pull off to the right and park immediately after you pass the FIRST bridge crossing. Walk down to stream and measuring cross section should be immediately visible just below the bridge.

Hahn's Ranch

Figure 19 – Standing bellowing stilling well and measuring cross-section, looking upstream

Figure 20 - Aerial image of stream site (parking spot immediately adjacent); credit Goolemaps

Navigating to the site: The Hahn Ranch site is located off of Highway 287 heading south away from Townsend. The pull-off is about 2 miles from town and is the FIRST left turn after Deep Creek is crossed (note: watch for sign and slow down; road is inconspicuous). Follow road down (either left or right) for about ½ mile. Park parallel to the first gate you see and head through that gate to access site. Measuring cross-section about 100 feet above conspicuous stillingwell site (in green, wooden box).

Sampling Schedule

2015-2020 - Flow will be monitored at all nine flow sites and temperature at priority sites (HP, CL, BM, and HR) at monthly intervals during the field season. Cross-sections at 10 sites (TBD) and beaver dam/redd counts will be completed once annually. All three fish assessments will be completed at least twice and the macroinvertebrate assessment at least once.

2020: 2015 - Flow and temperature measurements will continue to be collected monthly at two priority sampling sites: CL, BM, and HR. If flow monitoring at the Horse Pasture site is abandoned by Forest Service, this site will be monitored in place of Stocks Bridge. All other monitoring parameters will be optional from 2020 onward.

April	May	June	July	August	September	October	November
Flow, Photopoint	Flow, Photopoint,	Flow, Photopoint	Flow, Photopoint	Flow, Photopoint	Flow, Photopoint	Flow, Photopoint	Flow, Photopoint
	Temperature	Temperature	Temperature	Temperature	Temperature	Temperature	
		Cross-sections and photopoints, once annually					
							Beaver dam/redd count
					Macroinvertebrate sampling*		
						Juvenile Count	
Out-migrant trout count - Spring runoff period							
	Resident Trout Population Estimate - Spring or Fall Assessment (TBD)						

Sampling Methods

The following section describes the proper filed methods and data collection protocols for each of the monitoring parameters included in this study. For each monitoring parameter, the following elements will be addressed: Equipment and supplies, sampling preparation, step-by-step field procedures, post-sampling efforts, and equipment maintenance and calibration (if applicable). All protocols should be followed as instructed, to ensure accuracy and consistency of the data collections.

Stream Flow

Equipment and Supplies

- 100’ reel-type tape measure
- 2 clamps
- Flow meter – Marsh McBirney FLO-mate or Hach 950
- Measuring rod
- Flow monitoring field sheet and pencil
- GPS Camera

Sampling Preparation

Before heading to the field, one should familiarize themselves with how to operate both the flow meter and measuring rod. Below are simple instructions for using this equipment.

Operation of FLO-Mate

A Marsh-McBirney FLO-Mate or Hach950 flow meter will be used to measure stream velocity at the established flow cross sections. These units work by taking instantaneous velocity measurements and averaging them over a set period of time. When you receive the unit, the averaging time should be set to 40 seconds. If flow sensor is not already attached to measuring rod, secure it on to the bottom of the rod. This measuring rod will accurately place the sensor at the proper depth within the stream for accurate collection. The procedures for using the meter are shown below, followed by the step-by-step procedures for operating the meter with the measuring rod (pg. 24).

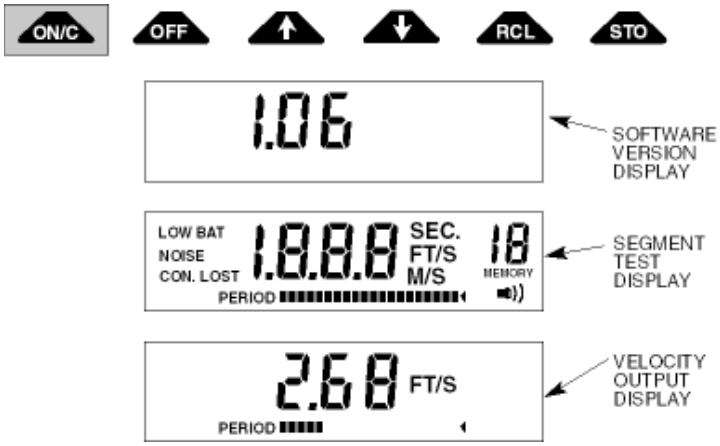


Figure 21 – Depiction of Marsh McBirney FLO-mate screen

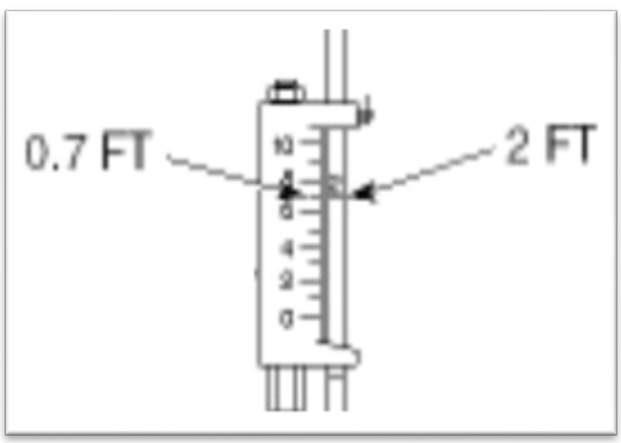
1. Hit the ON/C button once to turn on or clear meter during use.
2. The unit display will immediately begin averaging by showing the horizontal time bar under the velocity output. The time bar provides an indication as to the amount of time left until the display is updated.
3. At the end of the averaging period, record the value indicated in the “velocity” column on the field form.

Using the Measuring Rod

Because stream velocities differ at various depths within the channel, an accepted method for determining mean velocities of flow in a section is to measure the velocity at 60% (0.6) of the depth (from the top of water). To use the measuring rod, one should familiarize themselves with how to read stream depth and set the flow sensor to the proper 0.6 ft. depth. Below are instructions to do this once the interval has been located.

1. Once the rod is placed in its proper distance interval, note the height the water at the depth gauge rod. Each single mark represents 0.10 foot, each double mark represents 0.50 foot, and each triple mark represents 1.00 foot. Depth measurements should be recorded to the closest tenth of an inch (e.g. depth = 1.14, instead of rounding down to 1.1). **A trick to obtaining the most accurate depth measurement is to line up one's finer with the height of the water as it approaches the rod and place the tip of the finger on the rod that best represents this height.**

2. Once a depth is observed, line up the foot scale on the sliding rod with the tenth scale on the top of the depth gauge rod to put the sensor at 0.6 ft. down from the height of the water. If, for example, the total depth of the water is 2.70 feet, then line up the 2 on the foot scale with the 7 on the tenth scale (see figure below).



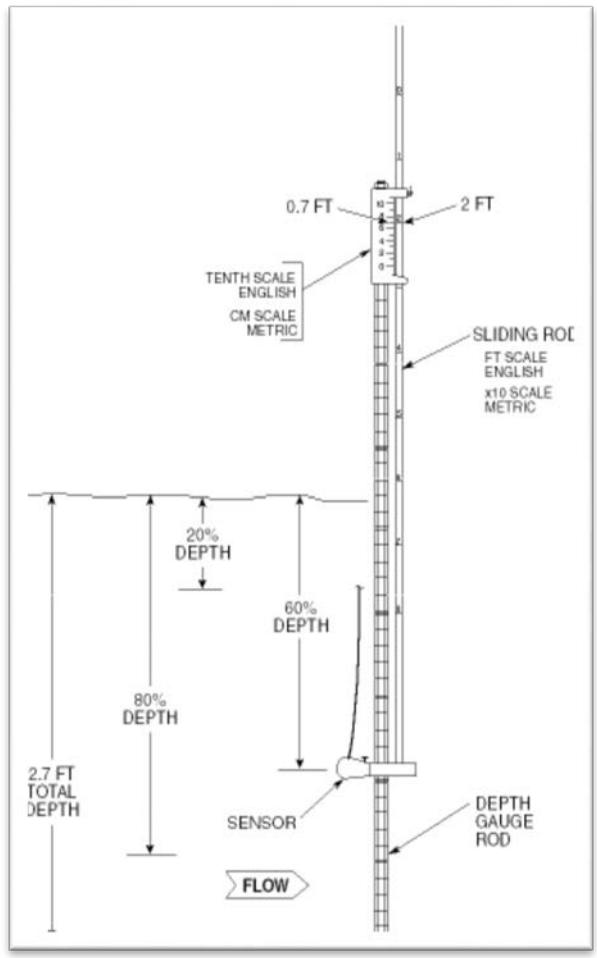


Figure 22 and 23 – Depiction of measuring rod and close-up of foot scale

Step-by-step Field Procedures

Figure 24 – Cross-section set up

1. Locate the cross sections at each monitoring site, which are pre-determined and marked with a set of highlighted stakes and/or metal rebar pins.

2. Stretch a tape measure across the channel to establish the cross-section. The beginning of the tape should be hooked to the rebar stake on the **left bank** (facing downstream).

3. Spacing intervals for flow measurements at each site are listed in Table 3 below. If spacing interval procedures are not available, be sure to collect *at least 20 flow measurements*. To do this, measure the wetted width and divide into 20 even intervals; taking a flow measurement at each. Measurements should be made in tenths of a foot for easier calculations.

4. Sand just below the tape at the left wetted edge of the
5. channel. Observe Left-Edge-of-Water (LEW) and record the tape measurement at that location with a zero depth. Continue measuring depths across the channel at your determined interval. You should finish on the opposite wetted edge with a zero measurement, recorded as Right-Edge-of-Water (REW).

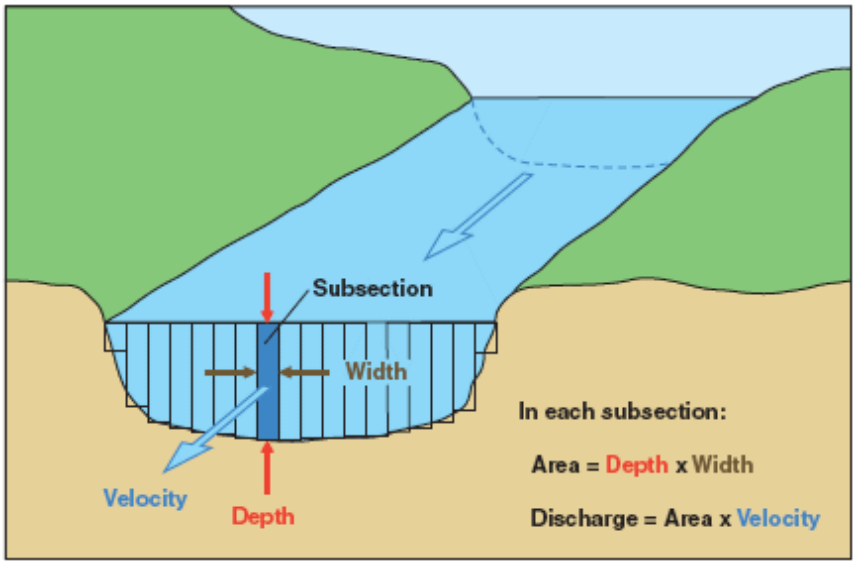


Figure 25 - Depiction of cross-section subsections

Post-sampling efforts

1. Field calculations should be entered into saved excel master spreadsheet on BCD's Google drive account immediately after sampling. This spreadsheet will automatically calculate flow when data is entered.

2. Once field calculations are complete, hardcopies should be stored in the BCD monitoring filing cabinet and scanned and transferred to the Google Drive account (see Google drive "Filing Instructions" folder).

3. At end of field season, all flow sampling sites will be visited and data will be downloaded onto OmniLog Data Management Program, Ver. 1.75 (see figure below). Continuous staff gauge height data from chart recorders will be collected monthly and stored in the BCD monitoring filing cabinet. Instructions for uploaded and exporting TruTrack data can be found at http://www.trutrack.com/omnilog/usermanual/index.html

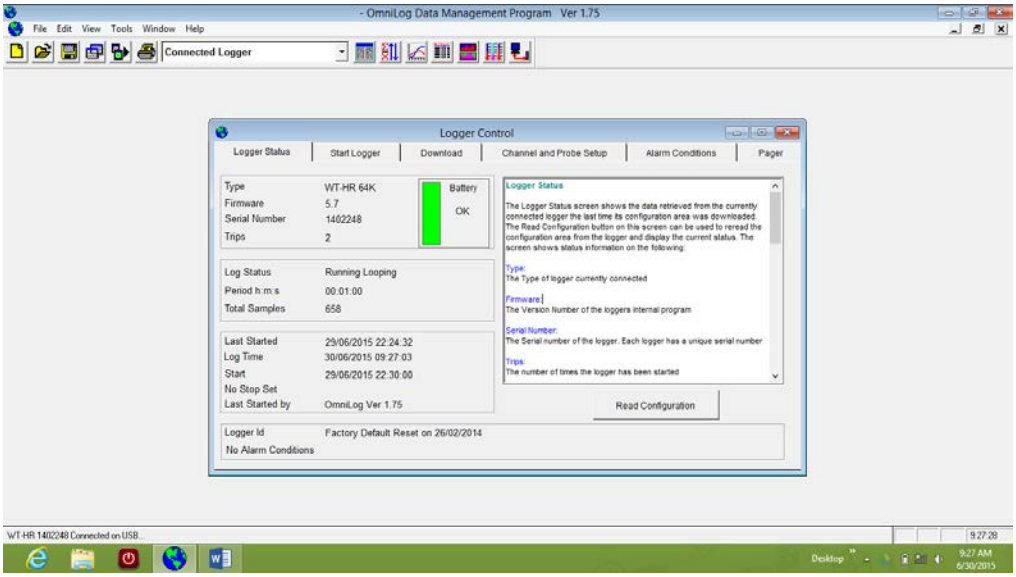


Figure 26 – Depiction of OmniLog software download page

Equipment Maintenance and Calibration

A zero check will be performed for the Hach 950 or Marsh McBirney flow-mate 2000 monthly before use in the field. TruTracks will be calibrated immediately before deployment in the field and upon retrieval. Calibration and maintenance procedures will be followed according to the appropriate manuals listed below (see attachments A,B,C):

TruTrack water data logger - http://www.trutrack.com/omnilog/usermanual/index.html
Hach 950 - www.**hachflow**.com/pdf/**FH950**_ds.pdf
Marsh McBirney 2000 - www.hachflow.com/pdf/Model_**2000_Manual**.pdf

Stream Temperature

Equipment and Supplies

Figure 27- Hobo data logger

- Hobo Water Temp Pro V2 loggers
- Metal Casing
- Metal wire

Sampling Preparation

All five Hobo data loggers will be deployed at the beginning of every field season, when conditions are safe enough to wade (sometime in May). Each Hobo will be placed in a metal casing (see picture below) to prevent damage during operation and will be attached to a sturdy wire pinned to the appropriated temperature-specific rebar pin in place at each site (marked by pink flagging tape). It is critical Hobos are attached to these pins to ensure Hobos collect temperature from the same location in the stream each year. In addition, the Hobos should be placed so that they are maintained in the main flow of the stream and lie in an area shaded by vegetation.

1. Detailed instructions on deploying and protecting the Hobo data loggers can be found in the Onset Hobo Temp Pro V2 manual and will be followed for the duration of this monitoring program. http://www.onsetcomp.com/files/manual_pdfs/10366-F-MAN-U22-001.pdf

Step-by-Step Field Procedures

Hobo data loggers collect data continuously and thus do not require field data collection. See the section below for how to retrieve data from Hobo units.

Post-Sampling Efforts

Data will be downloaded from Hobo data loggers at least once annually, at the end of the field season. Retrieving and downloading data will be done according to protocols laid out in the Onset Hobo Temp Pro V2 manual (above).

Equipment Maintenance and Calibration

Hobo data loggers will be calibrated immediately before deployment in the field and upon retrieval following the procedures listed in the Onset Hobo Temp Pro V2 manual (above).

Photopoints

Photopoints at will be taken in conjunction with flow monitoring and cross-section assessments. It is *essential* that photos are taken according to the procedures listed below to ensure that they exactly replicate previous photographs for drawing comparisons. The following procedures are adapted from the Standard Operating Procedures of the Madison Stream Team SAP (see SAP references)

Equipment and Supplies Needed

Required:

- GPS camera
- Photo-log data sheets
- Whiteboard
- Dry erase marker
- Rag to erase white board
- Topographic and/or road map
- Timepiece
-

Optional:

- Aerial photos if available
- Extra batteries for camera
- Ruler (for scale on close up views of streams and vegetation)
- Steel fence posts for dedicating fixed photo points in the absence of available fixed landmarks

Step-by-Step Field Procedures

1. First and foremost, ensure that the date and time in the camera are set correctly. If they are not correct and you cannot figure out how to reset them, make a note of the incorrect time in the field remarks section of the photopoint field form.

2. The first photograph should be of a whiteboard that displays the information about the site (see figure below). The wipe off sheet should be photographed before any site photos are taken and again after all photos are taken at the site to facilitate data management.

3. Locate flow/cross-section monitoring sites by referencing the description contained within the station location guide and by finding existing cross-section markers (highlighted rebar pins or metal stakes). Use GPS waypoints in Sampling Location table above if needed. Secure tape across cross-section before taking photographs.

4. Take AT LEAST three field photographs including: 1) cross-section view, 2) upstream view 3) and downstream view. Walk approximately 20 feet upstream and downstream of

tape to ensure the enough to get the stream banks are completely including in those photographs. Cross-section view should also be from the right bank and should also be taken approximately 20 feet back form the tape. Also include a shot of the staff gauge at flow monitoring sites.

5. Once all photos have been taken, update the wipe off sheet with the end time and the number of photos taken/jpeg numbers and photograph the board (example below). Record all applicable JPEG numbers on this whiteboard photo. A photo of the wipe off sheet should be the first and last photograph taken at each site.

6. Record ALL JPEG numbers and fill in field remarks section on photopoint field form.

Post-sampling efforts

Photos should be transferred off of the camera immediately after they are collected. Transfer photos to BCD Google Drive account under the appropriate "Images" folder nestled in each site folder.

Figure 28 – Example of whiteboard photopoint image

Cross-sections

BCD will follow the Laser Level Cross-section Method protocol established in DEQ's Field Procedures for Water Quality Assessment Monitoring manual; section 7.2.1 (see SAP reference). The following procedures are adapted from that section. The location of these sites are TBD.

Equipment and Supplies

- Sokkia model B30 Automatic Level
- 100' reel-type tape measure
- 2 clamps
- Sokkia Tripod
- Crain 20' Telescoping Leveling Rod
- GPS camera
- Cross-section monitoring field sheet and pencil

Sampling Preparation

1. Locate the datum stakes established at each cross-section and setup the surveying at this location. The instrument should be placed at an elevation higher than the highest feature required for the survey.

2. Stretch a measuring tape (in ft.) across the channel and attach to datum stakes on either side with clamps, making sure the tape is perpendicular to the direction of the flow. Zero side of tape should be hooked to the left bank (looking downstream).

3. Attach the clamp attachment exactly at the top of a stadia rod such that the side with the laser panel on the clamp is facing away from the numeric gradations on the stadia rod.

4. If bankfull is not obvious on both banks, locate bankfull on the side that is most obvious, place the base of the stadia rod at this point and adjust the rod height until the sensor intercepts the laser. Then move to the opposite bank and walk upslope holding the stadia rod vertical; mark bankfull at the point where the sensor again intercepts the laser.

5. Determine the distance on the tape between left bankfull and right bankfull. Divide this distance by 15-30 to obtain 15-30 equidistant points along the cross-section within bankfull (use 30 points for larger streams).

Step-by-Step Field Procedures

1. Begin the cross-section survey. Beginning at left bankfull and moving toward right bankfull, position the surveying rod on the stream substrate at each of the distances on the tape calculated in the previous step. Collect cross-section measurements at each calculated distance, as well as major breaks in bed elevation and key features such as

right bankfull (RBF), right water's edge (RWE), Thalweg (THL), left water's edge (LWE), and left bankfull (LBF).

2. At each distance point ("station"), **hold the stadia rod vertical with the base on the substrate** and adjust the rod height by extending or collapsing rod segments until the laser clamp indicates it is level with the laser level on the tripod (beeping will stop and high-pitched tone will remain constant).

3. Record the station (distance on the tape, ft) and the corresponding foresight (elevation, ft) at each station on the Channel Cross-Section (Laser) Form. Include notation indicating right bankfull (RBF), right water's edge (RWE), Thalweg (THL), left water's edge (LWE), and left bankfull (LBF). ***Note:*** It may be easiest to have one field crew member read the measurements off and the other record the information.

4. **Flood-prone area calculations**
   - Calculate in column "Height; Depth or Elevation":
     Line 1: Subtract RBF from itself = 0
     Lines 2 - X: Subtract RBF from each subsequent foresight measurement
   - Calculate the average of all values in the "Height" column = average elevation
   - Calculate the elevation of the flood-prone area (FPA):
     - Step 1: Measure foresight at Max Depth (Dmax)
     - Step 2: Measure foresight at right bankfull (RBF)
     - Step 3: Subtract step 2 from step 1 (Dmax – RBF)
     - Step 4: Multiply step 3 by 2 ((Dmax-RBF) x 2)
     - Step 5: Subtract step 4 from Step 1 (Dmax - ((Dmax-RBF) x 2))

5. Adjust the stadia rod height to the elevation of the FPA (step 5 above). Move the rod up the bank slope and along the cross-section (away from the stream channel) in both directions until the sensor intercepts the laser. Mark the FPA locations on both banks.

6. Use a rangefinder or tape to measure the straight-line distance between the two FPA locations. This is the flood-prone area width (Wfpa) (width of the channel at an elevation that is 2 times the maximum bankfull depth).

Post-sampling Efforts

1. Calculate mean depth and the width/depth ratio (bankfull width/mean depth)
2.
3. Calculate the entrenchment ratio = FPA width (Wfpa) / Bankfull width (Wbkfl)

4. After ensuring the appropriate sections of the field sheet are filled out, return field sheets to BCD office. These should be scanned and stored on BCD's Google Drive account and the hardcopies stored in the BCD filing cabinet.

Juvenile Trout Count

Equipment and Supplies

- Smith-root LR24 Backpack Electrofishing unit
- Nets
- Length board
- Notepad

Sampling Preparation

Before heading out to field, one should familiarize themselves with how to operate the electrofishing unit by reading the user's manual (see attachment D). Navigate to sampling site, located just upstream of Hahn's Ranch flow cross-section.

Step-by-Step Field Procedures

1. Set appropriate voltage and wave form on electrofishing unit (200 volts, 30 hertz)
2. Perform a single upstream pass, sampling for a duration of **1000-2000 seconds** (one person holding unit, another person netting fish)
3. Count and measure total of all fish captured and record on notepad
4. Record exact time (in seconds) of sampling effort on notepad
5. Make note of sampling conditions. including turbidity and flow patterns, and other field remarks

Post-Sampling Efforts

After sampling, the catch per unit effort for each individual species observed should be calculated. A qualitative assessment of how sampling conditions might have effected sampling efficiency should be included in analysis.

Equipment Maintenance and Calibration

Calibration of electrofishing unit will be performed immediately proper to use in the field. Procedures for maintenance and calibration can be found the user's manual (see attachment D).

http://www.smith-root.com/images/smith-root/downloads/70/07288.005_lr-24_electrofisher_manual.pdf

Out-migrant Trout Count

Equipment and Supplies

- 5’ diameter rotary screw trap
- Net
- Gallon buckets
- Length board
- Fish ID book
- Notebook and pencil
- Thermometer

Sampling Preparation

To perform this assessment, the screw trap needs to be installed in the creek immediately downstream of concrete head gate structure (above the Montana Ditch syphon). It will take at least 5 people to move screw trap and position it properly. Attach screw trap to head gate structure with rope to secure it in place.

Step-by-Step Field Procedures

Fish trap should be visited at least two times a day (morning and afternoon) during the high flow season so that debris jams can be removed if present. Once flows have gone down, visits can reduce to once a day. During the sampling period, trap should be visited and fish recorded at least 5 days/week.

1. Use a net to catch all fish caught in the trap, and move to gallon bucket.
2. Record the species *and* length of trout on notepad
3. Record the number of non-game fish species
4. Record stream conditions, including both staff gauge height, turbidity and any other field remarks
5. Place thermometer in stream for at least 10 minutes and record temperature
6. Perform periodic efficiency check

   To perform this check, mark portion of captured fish with fin clips, record their number on the appropriated field notes for the day, and re-release up stream. On the following day, make note of how many marked fish were re-captured and record the percent efficiency of the fish trap for that sampling day (Note: efficacy check needs to be performed at least once and again if stream conditions change)

Post-Sampling Efforts

Field sheets will be collected and stored together at the FWP office over the sampling period. At the end of this sampling, total fish movement will be calculated using number of fish observed and percent efficiency. Only data from "complete trap nights" (e.g. no debris jams observed the following morning) will be used to calculate the total number of trout.

Resident Fish Population Estimate

This assessment will be performed following the same procedures outlined in the 1991 "Initial Effects of Stream bank Stabilization on a Small Trout Stream" study performed by Water Virgil McClure.

Macroinvertebrate Sampling

This assessment will be conducted in accordance to procedures used by Hydrotech Inc. personnel in the 1997 and 2003 macroinvertebrate assessments on Deep Creek. See attachment E below for the final report of this assessment, which includes detailed description of the protocols used to collect and analyze macroinvertebrate data.

Revegetation Assessment

BCD is currently in the process of hiring a contractor to create a revegetation design for Deep Creek. Methods to monitor these sites post-implementation will be conducted according to recommendations established in this revegetation plan. The protocol for monitoring revegetation will be added to the next modified version

Beaver and Redd Counts

Equipment and Supplies
Notebook and pencil

Sampling Preparation
Walking entire reach takes several hours and this should be anticipated before heading out into the field. If planning on doing the whole length in a single day, start early and anticipate taking a full day (between 6-9 hours depending on physical prowess) to do this assessment.

Step-by-Step Field Procedures

Enter the stream at the at either the Highway 12 E bridge site and walk downstream to Clopton Lane bridge, or vice versa. Redds and beaver dams observed should be recorded for the entire length of this reach.

Post-Sampling Efforts

Following this assessment, data should be transferred to ongoing beaver dam/redd excel spreadsheet, which computes data to a graph for reporting purposes.

Figure 29 – Beaver dam on Deep Creek

Blank Field Data Sheets

Flow field sheet

Distant From Initial Point	Width	Depth	Depth of Obser.	Rev.	Sec.	VELOCITY			Area	Mean Depth	Angle Coef.	Discharge
						At Point	Mean in Vertical	Mean in Section				

BROADWATER CONSERVATION DISTRICT
DISCHARGE MEASUREMENT NOTES

Sta. No. _____ Comp. by _____ Checked by _____
_____ / _____

Date _____, 20____ Party _____

Area _____ Vel. _____ G.H. _____ Disc. _____

Width _____ Depth _____ No. Sec. _____ Method _____

Gauge height change _____ in _____ hr Suspended meter _____

Method coef. _____ Horiz. angle coef. _____ Susp. coef. _____ Meter _____

Rating for rod or suspension Meter _____ above bottom of weight Tags checked _____
_____ before measurement _____ on/after _____ Meas. Plots _____% diff. than rating

Wading, cable, ice; U/D side of bridge ; _____ ft, mile, above/below gauge;
or at established meas. section _____

GAUGE READINGS				
Time		Recorder	Inside	Outside
Weighted M.G.H.				
G.H. Correction				
Correct G.H.				

Measurement rated excellent (2%), good (5%), fair (8%), poor (over 8%); based on:

Cross section _____

Flow _____

Other _____

_____

Weather _____

Air temp. _____ °F @ _____ Water temp. _____ °F @ _____

Gauge _____

Record removed _____ Intake flushed _____

Observer _____

Control _____

Remarks _____

_____

_____

_____

G.H. at zero flow _____ ft

	Distant From Initial Point	Width	Depth	Depth of Obser.	Rev.	Sec.	VELOCITY			Area	Mean Depth	Angle Coef.	Discharge
							At Point	Mean in Vertical	Mean in Section				
80													
85													
90													
92													
94													
96													
97													
98													
99													
100*													
99*													
98*													
97*													
96*													
94*													
92*													
90*													
85*													
80*													

	Distant From Initial Point	Width	Depth	Depth of Obser.	Rev.	Sec.	VELOCITY			Area	Mean Depth	Angle Coef.	Discharge
							At Point	Mean in Vertical	Mean in Section				
80													
85													
90													
92													
94													
96													
97													
98													
99													
100*													
99*													
98*													
97*													
96*													
94*													
92*													
90*													
85*													
80*													

Cross-section field sheets (Adopted from MDEQ)

Sitewide Cross Section and Pebble Count (ISI)

Date: **Site Visit Code:**

Reach ID:

This form is used to measure cross sections and a sitewide pebble count to calculate ISI. Calculate the distance between measurements by dividing the bankfull width by 11 and rounding down. In each **"Distance"** cell enter the distance from the starting point. In each **"Depth"** cell enter the depth (ft) at that point. In each **"B-axis"** cell, enter the length (mm) of the b-axis of the selected particle.

Transect 1	Bankfull Width:					Distance between Measurements:						
	0%	9%	18%	27%	36%	45%	54%	63%	72%	81%	90%	100%
Distance (ft)	Bkf											Bkf
Depth (ft):												
B-Axis (mm):												
Transect 2	Bankfull Width:					Distance between Measurements:						
	0%	9%	18%	27%	36%	45%	54%	63%	72%	81%	90%	100%
Distance (ft)	Bkf											Bkf
Depth (ft):												
B-Axis (mm):												
Transect 3	Bankfull Width:					Distance between Measurements:						
	0%	9%	18%	27%	36%	45%	54%	63%	72%	81%	90%	100%
Distance (ft)	Bkf											Bkf
Depth (ft):												
B-Axis (mm):												
Transect 4	Bankfull Width:					Distance between Measurements:						
	0%	9%	18%	27%	36%	45%	54%	63%	72%	81%	90%	100%
Distance (ft)	Bkf											Bkf
Depth (ft):												
B-Axis (mm):												
Transect 5	Bankfull Width:					Distance between Measurements:						
	0%	9%	18%	27%	36%	45%	54%	63%	72%	81%	90%	100%
Distance (ft)	Bkf											Bkf
Depth (ft):												
B-Axis (mm):												
Transect 6	Bankfull Width:					Distance between Measurements:						
	0%	9%	18%	27%	36%	45%	54%	63%	72%	81%	90%	100%
Distance (ft)	Bkf											Bkf
Depth (ft):												
B-Axis (mm):												
Transect 7	Bankfull Width:					Distance between Measurements:						
	0%	9%	18%	27%	36%	45%	54%	63%	72%	81%	90%	100%
Distance (ft)	Bkf											Bkf
Depth (ft):												
B-Axis (mm):												
Transect 8	Bankfull Width:					Distance between Measurements:						
	0%	9%	18%	27%	36%	45%	54%	63%	72%	81%	90%	100%
Distance (ft)	Bkf											Bkf
Depth (ft):												
B-Axis (mm):												
Transect 9	Bankfull Width:					Distance between Measurements:						
	0%	9%	18%	27%	36%	45%	54%	63%	72%	81%	90%	100%
Distance (ft)	Bkf											Bkf
Depth (ft):												
B-Axis (mm):												
Transect 10	Bankfull Width:					Distance between Measurements:						
	0%	9%	18%	27%	36%	45%	54%	63%	72%	81%	90%	100%
Distance (ft)	Bkf											Bkf
Depth (ft):												
B-Axis (mm):												

ROSGEN STREAM CLASSIFICATION

Date: **Site Visit Code:**

Reach ID:

Bankfull Width (W_{bkf}) _____ **ft**

WIDTH of the stream channel, at bankfull stage elevation, in a riffle section.

Mean DEPTH (d_{bkf}) _____ **ft**

Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section.

AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section. _____ **Sq. ft**

Width/Depth RATIO (W_{bkf} / d_{bkf}) _____ **ft**

Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.

Maximum DEPTH (d_{mbkf}) _____ **ft**

Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and thalweg elevations, in a riffle section

WIDTH of Flood-Prone Area (W_{fpa}) _____ **ft**

Twice maximum DEPTH, or (2 x d_{mbkf}) = the stage/elevation at which flood-prone area WIDTH is determined. (riffle section)

Entrenchment Ratio (ER) _____ **ft**

The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH. (W_{fpa} / W_{bkf}) (riffle section)

Channel Materials (Particle Size Index) D50 _____ **mm.**

The D50 particle size index represents the median diameter of channel materials, as sampled from the channel surface, between the bankfull stage and thalweg elevations.

Water Surface SLOPE (S) _____ **ft/ft**

Channel slope = "rise" over "run" for a reach approximately 20-30 bankfull channel widths in length, with the "riffle to riffle" water surface slope representing the gradient at bankfull stage.

Channel SINUOSITY (K) (in office) _____ **ft/ft**

Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL/VL); or estimated from a ratio of valley slope

Existing Rosgen Channel Type:

Potential Rosgen Channel Type:

Photopoint field sheet

Photo Point Field Form		
Site ID: Date: Time: Team Member(s):		
Description	**JPEG Number(s)**	**Remarks**
First white board photo		
Cross-section view		
Upstream view		
Downstream view		
Staff gauge view (if applicable):		
Last whiteboard photo		

Attachment A – Hach 950 Handheld Pro Flowmeter user's manual

Attachment B - Marsh McBirney FLO-mate 2000 user's manual

Attachment C - Hobo Water Temp Pro V2 user's manual

Attachment D - LR-24 Electrofisher user's manual

Attachment E – "A Biological Assessment of Sites on Deep Creek: Broadwater, CT", 2003